REMARKS

The Final Office Action mailed July 3, 2001, has been received and reviewed. Claims 1 through 38 are currently pending in the application. Claims 1 through 38 stand rejected. Reconsideration of the application is respectfully requested.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 5,814,563 to Ding et al. in View of U.S. Patent No. 5,626,716 to Bosch et al.

Claims 1 through 38 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ding et al. (U.S. Patent No. 5,814,563) in view of Bosch et al. (U.S. Patent No. 5,626,716). Applicants respectfully traverse this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Bosch teaches a dry etch process in which a chemical combination that includes CHF_3 (Freon-23) and neon (Ne) is used to remove doped silicon oxide with selectivity over undoped silicon oxide, silicon nitride, silicide, and silicon. *See, e.g.*, col. 2, lines 34-44. Any of these materials may, therefore, be used as an etch stop when a doped silicon oxide is being dry etched with the disclosed combination of **solely gaseous** CHF_3 and Ne. *See, e.g.*, col. 4, lines 43-48. Bosch does not disclose, teach, or suggest any dry etchant chemical combination that includes $C_2H_xF_y$, where x is an integer from three to five, inclusive, y is an integer from one to three, inclusive, and $x + y = 6$. Nor does Bosch disclose, teach, or suggest that any such dry etchant

chemical combination may be used to dry etch doped silicon oxide with selectivity over undoped silicon oxide or even that doped silicon oxide may be dry etched with such a chemical combination.

Ding teaches, among other things, a dry etch process in which a chemical combination that includes a fluorocarbon gas, an ammonia (NH_3) generating gas, and a carbon-oxygen gas is used to etch dielectric materials such as doped and undoped silicon dioxide. *See, e.g.*, col. 2, lines 32-43. Ding also teaches that, by use of the chemical combination disclosed therein, dielectric materials, such as doped and undoped silicon oxides, may be removed with selectivity over underlying substrate materials, such as silicon or gallium arsenide. *See, e.g.*, col. 3, lines 49-54. Ding further provides that the etchant chemical combination etches dielectric materials with selectivity over both photoresist materials and polysilicon. Col. 7, lines 44-49. Importantly, Ding teaches that the NH_3 generating gas is caused to form a portion of **gaseous and liquid** NH_3 generating phases, which adsorb on the substrate during the etching process and react with the fluorohydrocarbon gas on the surface of the substrate. Col. 6, lines 32-37. Among the various fluorocarbons that are specifically disclosed in Ding as being useful in the chemical combination are CHF_3 and $C_2H_4F_2$. *See, e.g.*, col. 2, line 62, to col. 3, line 2. Ding does not, however, disclose, teach, or suggest that the chemical combination disclosed therein or any other completely dry gaseous etchant chemical combination that includes $C_2H_4F_2$ may be used to etch doped silicon oxide with selectivity over undoped silicon oxide.

One of Ordinary Skill in the Art Would Not Have Been Motivated to Combine the Teachings of Bosch and Ding in the Asserted Manner

The 35 U.S.C. § 103(a) obviousness rejections of claims 1 through 38 are improper because there is no motivation to combine the references.

M.P.E.P. § 2142 provides:

> The initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done. 'To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or **the examiner must present a convincing line of reasoning** as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references,' *Ex parte Clapp,* 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985) (Emphasis supplied). . .

Thus, the Office's burden of setting forth a *prima facie* case of obviousness is substantial.

M.P.E.P. § 2142 further provides:

> When the motivation to combine the teachings of the references is not immediately apparent, **it is the duty of the examiner to explain why the combination of teachings is proper**. *Ex parte Skinner,* 2 USPQ2d 1788 (Bd. Pat. App. & Inter. 1986) (Emphasis supplied).

It is respectfully submitted that, despite the directive to provide a convincing line of reasoning, no such reasoning has been provided to support the assertion that one of ordinary skill in the art would have been motivated by Bosch, Ding, or the teachings that were generally available in the art before the priority date for the above-referenced application to combine the teachings of Ding and Bosch in the manner asserted in the outstanding Office Action. Rather, the teachings of Ding have been extrapolated so that they could be applied to the teachings of Bosch. Stated another way, it has been asserted that, because Ding discloses that either CHF_3 or $C_2H_4F_2$ may be used in a plasma etching environment containing gaseous and liquid phases for the purpose of etching dielectric materials with selectivity over both photoresist materials and polysilicon, CHF_3 and $C_2H_4F_2$ are equivalent for the purpose of etching doped silicon oxide with selectivity over undoped silicon oxide in the purely gaseous plasma etching environment of the present invention. Essentially, the outstanding Office Action appears to assert that CHF_3 and $C_2H_4F_2$ are known equivalents in any etching environment drawn to any etching selectivity. However, the references guard against this conclusion, as discussed hereinbelow.

The Office has failed to show $C_2F_xH_y$, where x is an integer from three to five, y is an integer from one to three, and $x + y = 6$, is a known equivalent of CHF_3 in its plasma etching characteristics. Bosch notes that "elaborate theories have been developed to explain the plasma etching process, in practice most such processes have been developed largely by experimentation involving trial and error . . . such experimentation can be time consuming and success often depends on chance." Col. 1, lines 63-67. Col. 2, lines 1-5. In addition, Ding observes "although the reaction mechanism is not fully understood it is believed that the following reaction mechanism provides increased etch rates and higher etching selectivity." Col. 6, lines 16-19. Despite both references acknowledging that the underlying mechanisms of plasma etching are not known, an assertion has been made, without supporting motivation or teachings from the prior art references, that the use of $C_2F_xH_y$, where x is an integer from three to five, y is an integer from one to three, and $x + y = 6$ is an **obvious** substitution of a **known** equivalent structure with respect to plasma etching doped silicon dioxide with selectivity over undoped silicon oxide in a solely gaseous plasma etching process. It is respectfully submitted that the Office has failed to provide a convincing line of reasoning for combination of references drawn to different etching purposes and environments.

It has been further asserted that the substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution and cites *In re Fout,* 213 USPQ 532 and *In re Susi,* 169 USPQ 423, among others, as supporting substitution of known equivalent structures. *In re Fout* considers the combination of two patents aimed at an identical purpose; namely, Pagliaro and Waterman each teach a method for separating caffeine from oil. The proposed combination of Bosch and Ding may be distinguished, however. Bosch teaches a dry etching process for etching doped silicon oxide with selectivity over undoped silicon oxide, silicon nitride, silicide, and silicon. Ding, on the other hand, teaches a method for etching dielectric materials, including *both* doped and undoped silicon oxides, with selectivity over photoresist materials and over polysilicon. Thus, the

combination of references proposed in the outstanding Office Action involves patents aimed at different purposes and is therefore not analogous to *In re Fout.*

In re Susi concerns rejection of a patent for a plastic stabilization additive. However, the examiner of the case notes that the "appellant has shown no unobvious results" with respect to the additive over the prior art. In this respect, the present case may be distinguished, since applicant has shown that selectivity of etching doped silicon oxide over undoped silicon oxide may be achieved by way of $C_2H_xF_y$. Further, *In re Susi* concerns references that are drawn to chemical compounds used for the same purpose, namely, plastic stabilization. As noted hereinbefore, Ding is drawn to etching dielectric materials, including *both* doped and undoped silicon oxides with selectivity over both photoresist materials and polysilicon, not the applicant's etching of doped silicon oxides selectively over undoped silicon oxide. Thus, the combined cited art is not aimed at the same purpose. Further, the present invention shows that selectivity of etching doped silicon oxide over undoped silicon oxide may be achieved by way of $C_2H_xF_y$. Accordingly, the cited case does not support the proposed combination of references.

It is respectfully submitted that one skilled in the art would not have been motivated to combine the teachings of Ding and Bosch because the etchants disclosed in each reference are directed at different purposes, as outlined above. "Consideration must be given to the purpose for which an ingredient is used in a patent, the qualities it has when combined with the other ingredients, and the function which it is intended to perform." *Graver Tank & Mfg. Co. v. Linde Air Products Co.*, 85 U.S.P.Q. 328, 331.

Further, there are several additional reasons that one of ordinary skill in the art would not have been motivated to replace the CHF_3 of Bosch's CHF_3-Neon etchant system with the $C_2H_4F_2$ of Ding to create a dry etchant that would remove doped silicon dioxide with selectivity over at least undoped silicon dioxide.

First, the etchant system disclosed in Bosch purportedly achieved the desired result: etching doped silicon oxides with selectivity over undoped silicon oxides, so there would be no motivation to modify the system as disclosed.

Second, the selectivities of the etchant systems that are respectively disclosed in Bosch and Ding are very different. While Bosch teaches an etchant system that is useful for dry etching doped silicon oxides with selectivity over undoped silicon dioxides, Ding discloses multi phase etchant systems that are useful for etching dielectric materials, including *both* doped and undoped silicon oxides, with selectivity over photoresist materials and over polysilicon. Therefore, the operative principles underlying each reference are very different. Further, Ding teaches that etching rates may be increased by a NH_3 compound undergoing liquefaction upon the surface of the substrate, whereas Bosch teaches gaseous interactions only of CHF_3 and Ne. "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." M.P.E.P. §2143.01 (citing *In re Ratti* , 270 F.2d 810, 123 USPQ 349 (CCPA 1959).

Third, the etchant systems of both Bosch and Ding require the use of additional components, none of which are common to both references. Nonetheless, Bosch teaches that the use of neon along with CHF_3 provides the desired selectivity for doped silicon oxides over undoped silicon oxides and other materials, *see* Bosch, col. 2, lines 34-44, while Ding teaches that the use of a multi phase etchant system including one of the listed fluorocarbons (e.g., CHF_3 or $C_2H_4F_2$), an ammonia-generating gas/liquid, and a carbon-oxygen gas is useful for etching dielectric materials, including both doped and undoped silicon oxides, with selectivity over photoresist materials and polysilicon.

The disclosed use of CHF_3 as a possible component of both the etchant system of Ding and the etchant system of Bosch does not provide the motivation to combine the teachings of Ding and Bosch in the manner that has been suggested in the outstanding Office Action. In fact, Bosch itself warns against reading any such motivation into the references by disclosing, at col. 1, line 57, to col. 2, line 5, that, although many different gaseous media have been used in dry etching, successful use of etchants or etchant combinations to achieve a desired result often

depends on *chance* due to the number of variables involved, including the materials to be etched, the selectivity, and the degree of anisotropy.

For these reasons, it is respectfully submitted that one of ordinary skill would not have been motivated by the teachings of either Bosch or Ding, or by the knowledge generally available to those of ordinary skill in the art before the priority date of the referenced application, to replace CHF_3, a component of an etchant system that was known to provide the desired selectivity result, with $C_2H_4F_2$, a different chemical that had previously been used in a multi phase etching system which did not provide the desired etchant selectivity for doped silicon oxides over undoped silicon oxides.

Both Bosch and Ding Teach Away from the Asserted Combination of the Teachings Thereof

Further, it is respectfully submitted that Bosch and Ding teach away from the proposed combination thereof. It is improper to combine references where the references teach away from their combination. MPEP § 2145 (citing *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983)). Further, a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

Specifically, the chemical combination disclosed in Bosch is useful for etching doped silicon dioxide with selectivity over undoped silicon dioxide. Conversely, Ding teaches, at col. 3, lines 57-61, that the chemical combinations disclosed therein, which may, among other components, include $C_2H_4F_2$, are useful for etching *both* doped silicon dioxide (BPSG) and undoped silicon dioxide. Based on the teachings of Ding, one skilled in the art arguably would have concluded that the use of $C_2H_4F_2$ in an etching system would not have provided etching of doped silicon dioxide with selectivity over undoped silicon dioxide. The mere fact that references can be combined or modified does not render the resulting combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680,

16 USPQ2d 1430 (Fed. Cir. 1990). Thus, Ding teaches away from the asserted substitution of the CHF_3 disclosed in Bosch with the $C_2H_4F_2$ disclosed in Ding to provide a chemical combination that will etch doped silicon dioxide with selectivity over undoped silicon dioxide.

The Combination of Bosch and Ding Does Not Teach or Suggest Each and Every Claim Element

It is respectfully submitted that, when taken either alone or in combination, Bosch and Ding do not teach or suggest each and every element of any of claims 1-38.

Independent Claim 1 recites, "A dry etchant, comprising a component with the general formula $C_2H_xF_y$, where x is an integer from 3 to 5, inclusive, y is an integer from 1 to 3, inclusive, and $x + y = 6$, said dry etchant being formulated to etch doped silicon dioxide with selectivity over at least undoped silicon dioxide."

Independent Claim 20 recites, "A dry etchant comprising a component with the general formula $C_2H_xF_y$, where x is an integer from 3 to 5, inclusive, y is an integer from 1 to 3, inclusive, and $x + y = 6$, said dry etchant being formulated to etch doped silicon dioxide at a faster rate than at least undoped silicon dioxide."

Neither Bosch nor Ding, taken either alone or in combination, teaches a dry etchant comprising $C_2H_xF_y$, where x is an integer from 3 to 5, inclusive, y is an integer from 1 to 3, inclusive, and $x + y = 6$, which may be formulated to etch doped silicon oxide with selectivity over or at a faster rate than undoped silicon oxide, as is recited in each independent claims 1 and 20, respectively.

Therefore, the combination of Bosch and Ding does not teach or suggest each and every element of either claim 1 or claim 20.

Claims 2-19 and 20-38 are respectively allowable, among other reasons, as depending from claims 1 and 20, which are allowable.

In view of the foregoing, it is respectfully submitted a *prima facie* case that the teachings of Ding and Bosch could be combined under 35 U.S.C. § 103(a) to render obvious the subject matter recited in any of claims 1-38 has not been set forth. It is, therefore, submitted that each of claims 1-38 is allowable under 35 U.S.C. § 103(a). Accordingly, reversal of the 35 U.S.C. § 103(a) rejection of claims 1-38 is respectfully requested.

CONCLUSION

Claims 1-38 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should it be determined that additional issues remain which might be resolved by way of a telephone conference, the Office is respectfully invited to contact the undersigned attorney.

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Date: September 4, 2001
BGP/ps:djp
Enclosure: Version With Markings to Show Changes Made

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

38. (Twice amended) The dry etchant of claim 22_{1}[.] wherein relative concentrations of said component and said primary etchant in said combination are tailored to provide for at least one of a particular etch selectivity of doped silicon dioxide over undoped silicon dioxide, a particular etch selectivity of doped silicon dioxide over silicon nitride, and a particular etch rate of doped silicon dioxide.